Space Weather Technical Forecast

Issued on Friday, 17 March 2023 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: No significant activity expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours with isolated C-class flares, with a pair of C6.4 flares observed around 17/0640UTC, originating near a newly emerging active region close to the southeast limb. This event produced an eastwards directed CME which is not Earth directed There are currently seven numbered and two unnumbered sunspot regions on the visible disc. The majority of the regions are small, weak and either stable or weakly decaying. The aforementioned new region on the southeast limb is the largest sunspot on the disc, and may be the leader spot of a more significant region which has yet to emerge. A filament eruption in the southwest of the disc has been observed from SDO around 17/1000UTC, with a probable CME which will be analysed, otherwise no Earth directed CME's have been observed in the past 24-hours.

Solar Wind / Geomagnetic Activity: The solar wind started the period at slightly elevated levels, reaching a peak at L1 of 534km/s at 16/1325 UTC, following the attributed CME arrivals combined with a HSS around 15 March. Winds have been gradually declining to end the period around 440km/s. Density started slightly above average with a slow downwards trajectory. The total IMF strength persisted at weak levels with a flat trend. The north-south component Bz was also weak, with a maximum southward component of -5nT at 17/0327 UTC. The Phi angle was mostly positive (away from the Sun). Geomagnetic activity remained at Quiet levels (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at close to background. The high energy electron flux (greater than 2MeV) has been at mostly background levels. The associated 24 hour Electron fluence has been well below Active (1e10 integrated flux), with an increasing trend. At 17/0001UTC the observed fluence was 1.92e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity starting at Low levels with a chance of an isolated Moderate class flare, most probable from the newly emerging sunspot region in the southeast and from any returning regions which are likely to arrive from the far side during the next few days.

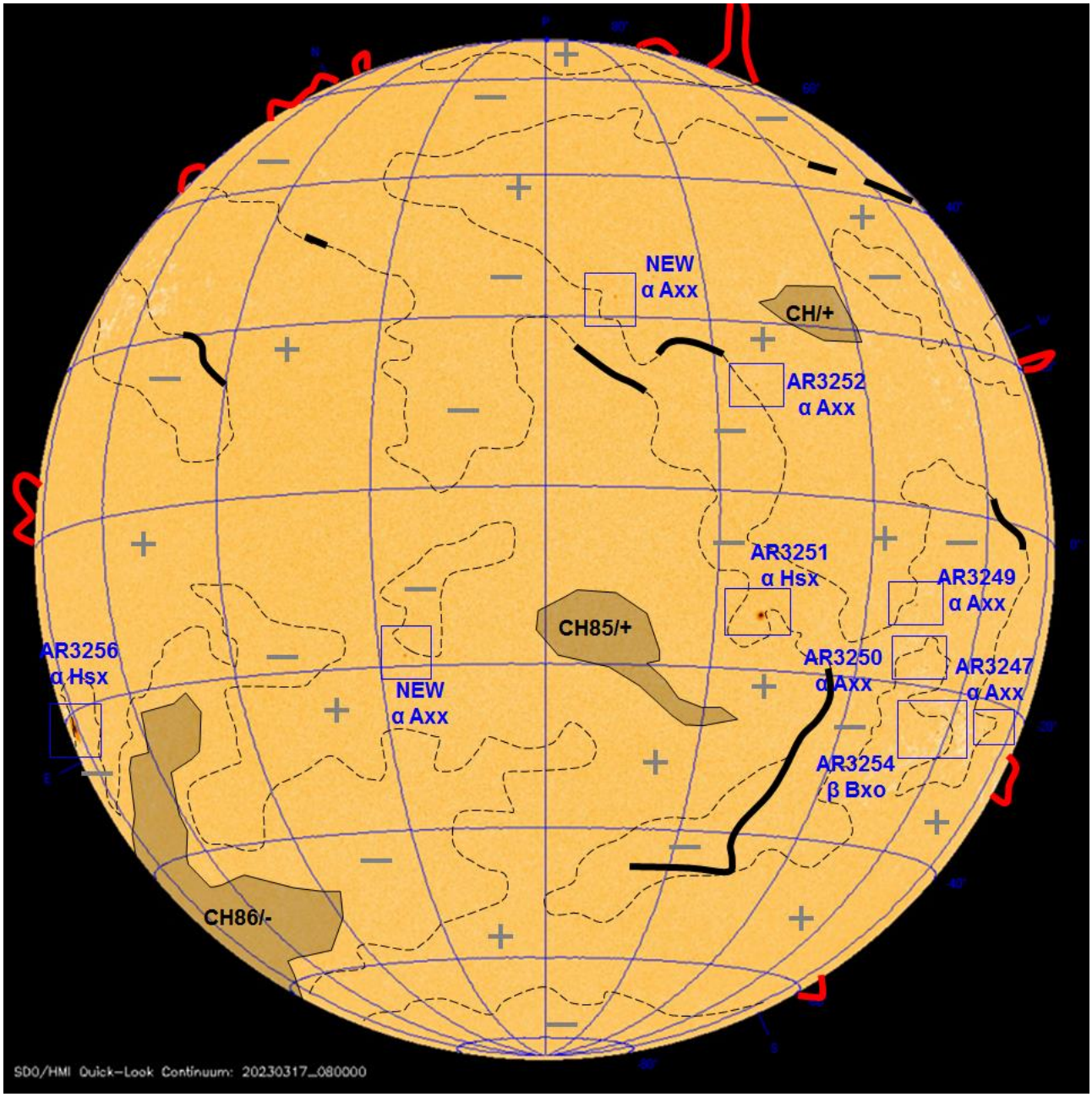
Solar Wind / Geomagnetic Activity: Solar winds starting at slightly elevated levels through Days 1-2 (17-18 Mar) under the waning influence of coronal hole high speed stream effects and CME influence from arrivals on 15th Mar. Solar winds continue to decline through Day 3 to reach slow-ambient. An enhancement is possible late Day 3 (19 Mar), more likely through Day 4 (20th), as connection to a HSS from CH85/+ becomes established. No Earth directed CME's are expected during the forecast period. Geomagnetic conditions are forecast to be largely Quiet (Kp 0-2), with a chance of isolated Unsettled (Kp 3) intervals until late day 3 and through day 4. Then becoming Unsettled to Active (Kp 3-4) with a slight chance of a G1/Minor Storm interval.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is expected to remain at or near background levels throughout. The high energy electron flux is expected to persist at largely Background levels on Day 1 (17 Mar), but is then likely to increase slightly through the rest of period. Flux levels are expected to reach predominantly Moderate levels, with a chance of reaching High levels by late Day 2 (18 Mar). The associated 24 hour electron fluence is expected to persist at below the Active level (1e8 integrated flux), but with an upward trend.

Figure 1. Solar Analysis Valid 0800UTC, 17 March 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

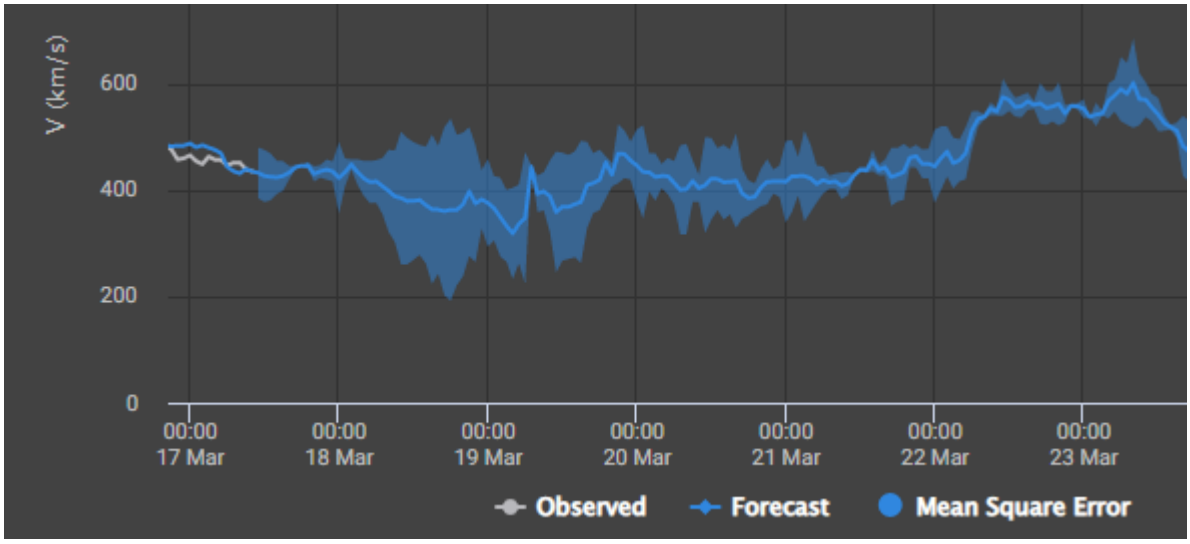
The solar wind is currently around 440 km/s, and is expected to remain at similar, slightly elevated levels through Days 1-2 (17-18 Mar) under the waning influence of coronal hole high speed stream effects and CME influence from arrivals on 15th Mar. Solar winds decline through Day 3 to reach slow-ambient levels. An enhancement is possible late Day 3 (19 Mar), more likely through Day 4 (20th), as connection to a HSS from CH85/+ becomes established. This coronal hole feature is small, and appears to be in a similar size and position compared to the previous rotation when solar winds reached 450 km/s. Therefore CH85 does not appear to be a significant coronal hole feature, leading to only a slight chance of significant geomagnetic activity. No Earth directed CME's are expected during the forecast period. Geomagnetic conditions are forecast to be largely Quiet (Kp 0-2), with a chance of isolated Unsettled (Kp 3) intervals until late day 3 and through day 4. Then becoming Unsettled to Active (Kp 3-4) with a slight chance of a G1/Minor Storm interval.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model (SWPM), indicating declining trend in levels.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

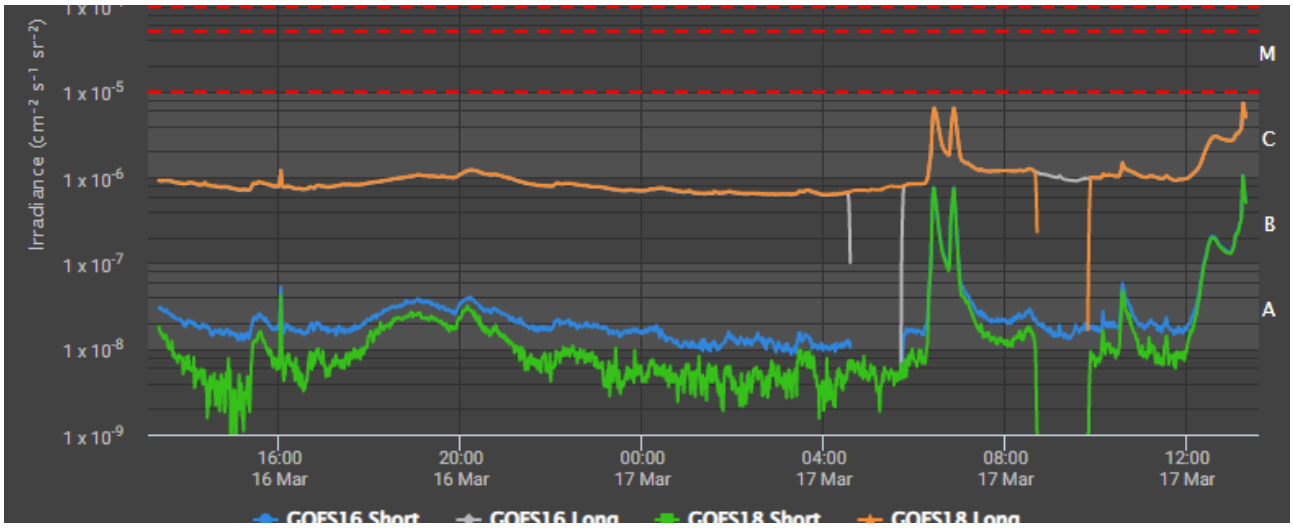
© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the past 24 hours with three isolated C-class flares. There are currently six numbered sunspot regions on the visible disc, with three unnumbered regions. The majority of the regions are small, weak and either stable or weakly decaying. The new emerging region on the southeastern limb is the largest sunspot on the visible disc. In addition to the spots, there are number of filaments on the disc, which should any erupt, could be another source of C-class flares. Solar activity is Low, with a chance of isolated M-class flares. The new unnumbered region was likely the source of the two C-class flares around 17/0640UTC. Solar activity remaining mostly Low with a Chance (20-30%) of further M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	30	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux plot at GEO with isolated C-class flares observed over past 24 hours.



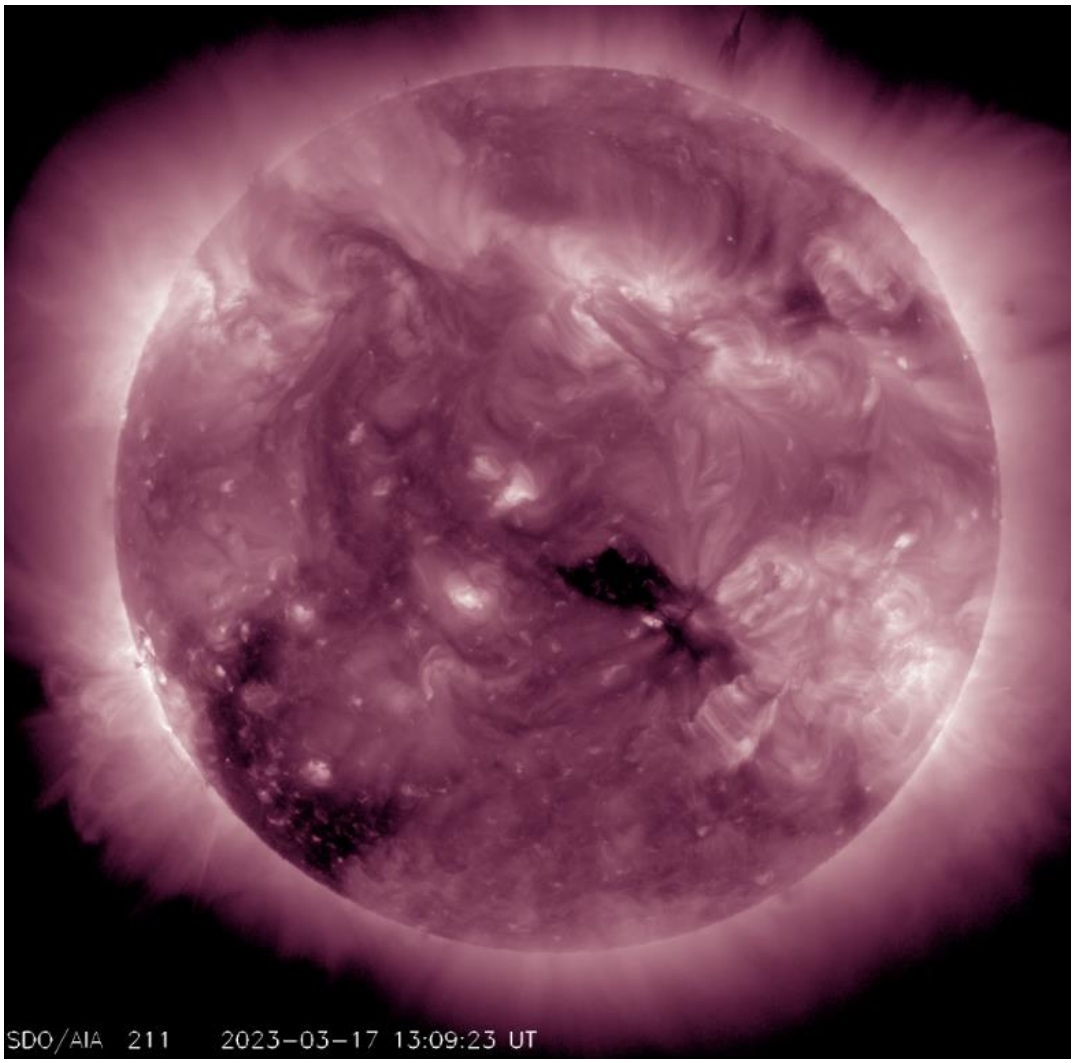
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10 MeV) proton flux, as observed by GOES16, is expected to remain at background or slightly elevated levels throughout the forecast period. Given the simplicity of the sunspot regions currently on the disc, no further significant enhancements are expected, unless any further large far-sided eruptions occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO-aia 211 imagery showing coronal holes on visible disc.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux at GEO, as observed by GOES-16, is expected to persist at largely Background levels on Day 1 (17 Mar), before probably increasing slightly through the rest of period. Flux levels are expected to reach predominantly Moderate levels, with a chance of reaching High levels by late Day 2 (18 Mar). The associated 24 hour electron fluence is expected to remain below the Active level, gradually trending upwards during Days 2-4 (17-19 Mar), with only a slight chance of the Active threshold being reached late in the period. Therefore Met Office REFM output is currently considered to be giving good guidance for the overall forecast trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output over past three days.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.